# CROP DIVERSIFICATION IN AKOLA DISTRICT



**THESIS**

**Submitted to**
**Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola**
**in partial fulfilment of the requirements**
**for the Degree of**

**MASTER OF SCIENCE**
**IN**
**AGRICULTURE**
**(AGRICULTURAL ECONOMICS)**

**By**

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**Enrolment Number - JJ-2172** **2013**

## DECLARATION OF STUDENT

I hereby declare that the experimental work and its interpretation of the thesis entitled **"CROP DIVERSIFICATION IN AKOLA DISTRICT"** or part thereof has neither been submitted for any other degree or diploma of any University, nor the data have been derived from any thesis / publication of any University or Scientific Organization. The sources of material used and all assistance received during the course of investigation have been duly acknowledged.

**Place** : Akola.

(Miss. Gore Nitisha Hirachand)

**Date** : 28/05/2013

Enrolment No. JJ-2172

# CERTIFICATE

This is to certify that the thesis entitled **"CROP DIVERSIFICATION IN AKOLA DISTRICT"** submitted in partial fulfillment of the requirement for the degree of "**Master of Science in Agriculture (Agricultural Economics)"** of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola is a record of bonafide research work carried out by **Miss. Gore Nitisha Hirachand** under my guidance and supervision.

The subject of thesis has been approved by the Student's Advisory Committee.

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Date : 28/05/2013

Dr. V. K. Khobarkar
Chairman,
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THESIS APPROVED BY THE STUDENT'S ADVISORY COMMITTEE INCLUDING EXTERNAL EXAMINER (AFTER VIVA–VOCE)

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**Place** : Akola.
**Date** : 28/05/2013

(Miss. Gore Nitisha Hirachand)
Enrollment No. JJ-2172

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## (B) List of Figures

## (D) Abbreviations

| | | |
|---|---|---|
| % | - | Per cent |
| / | - | Per |
| Agril. | - | Agricultural |
| Dr. PDKV | - | Dr. Panjabrao Deshmukh Krishi Vidyapeeth |
| DSAO | - | District Superintendant Agriculture Office |
| e.g. | - | Exampli gratia (For example) |
| Econ. | - | Economics |
| *et. al.* | - | Et alia (and others) |
| etc. | - | Et cetra |
| Fig. | - | Figure |
| Ha | - | Hectare |
| i.e. | - | That is |
| J. | - | Journal |
| M.S. | - | Maharashtra State |
| PGI | - | Post Graduate Institute |
| Sr. No. | - | Serial Number |

## (F) Thesis Abstract

| | | |
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| b) | **Full name of student** | : **Miss. Gore Nitisha Hirachand** |
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## ABSTRACT

The research entitled "Crop diversification in Akola district" was carried with objectives to study the performance of major crops, changes in cropping pattern in Akola district, extent of crop diversification and benifits of crop diversification. The present study was based on secondary data collected from different government publications. The data covered a period of 15 years i.e. 1995-96 to 2009-10. In all 6 crops were considered

for study. These crops covered more than 80 per cent of the total cropped area of the study area. The growth rate and coefficient of variation was used to examine performance of major crops, Simple tabular analysis was used to examine the changes in cropping pattern in various tahsils of Akola district. In order to study the extent of crop diversification Herfindahl index and entropy index has been used. In order to study the economics of crop diversification, land concentration ratio in tahsils with comparative advantage was computed for selected years.

Tahsilwise analysis showed that the area under kharif jowar has found to be decreased in all the tahsils of Akola district. Area under soybean crop was increased in Balapur and Murtijapur tahsil. The area under wheat has found to be increased in Akot and Patur tahsils. Cotton still remains as major crop of the district.

In Akot, Balapur, Murtijapur and Patur tahsils along with Akola district crop diversification has significantly increased during the study period. The diversification from subsistence crop to more commercial crops were took place in selected tahsils. Cotton and Soybean shows increasing land concentration ratio from year 1995-96 to 2009-10, so soybean is more adventitious crops in Akot, Balapur, Murtijapur and Patur tahsils of Akola district.

# CHAPTER I

# INTRODUCTION

## 1.1 Background Information

Agriculture being one of the major sector associated with the country's population, has attracted much attention since independence for its development. It is therefore, got the topmost priority in the Nation's Five Year Plans. The first two decades after independence did not show much growth of agriculture. It was attributed to expansion of land area sown under different crops and not by technological changes. The shift of farming before independence and after independence of the country has an effect of the behaviour of the farmers who were more adherent to traditional farming. Because of the increasing pressure of population and stagnant productivity of agriculture, the country was heavily dependent on import of food grains to meet the internal demands of food.

Agriculture depends mostly on unpredictable behaviour of mansoon. Indian farming is therefore not remunerative. India possesses 328 million hectares of land, out of which 143 million hectares is under cultivation and 123 million hectares under forest, postures, fallows, grooves and wasteland etc. which is uncultivable. Fifty million hectares land has access to irrigation and over two third area of the cultivable land is under rainfed cultivation (Hegde, 1990).

Diversification of agriculture is becoming important as farmers as faced with flowing restrictions of market imbalances between supply and demand for their products and farmers must be aware of market trends before he hope to diversify.

Maharashtra is an important state and has been considered as one of the progressive state in India. In India, it is second largest state in population and third in geographical area. Since its formation in 1960, the state has secured higher growth rate vis-à-vis Indian economy for almost three decades and needs to move at a much faster pace. Planning commissions assessment indicate that the average annual growth rate for Maharashtra would be 10 per cent. The compound growth rate achieved during 2009-10 was 8.59 per cent. It was envisaged that the growth rate could be achieved by adopting comprehensive policy package and institutional reforms.

Geographically the state has 37.58 lakh hectares of land. Out of which 20.13 per cent and 53.90 per cent are under forest and the net sown area respectively. With the population pressure it may not be possible to bring any more acreage of land under cultivation. The population of the state is 11.23 crore (2011 census) out of this nearly 54.77 per cent live in rural area. The growth rate of population over the previous census (2001) is around 10.3 and 23.7 per cent in the rural and urban area respectively with the male female ratio of 1000:925 and overall literacy percentage is 82.91. The higher growth rate in the urban area may indicate some shift of rural population to urban area in search of work, effecting in the depletion of agricultural labour force of rural area (Directorate of Census Operation, M.S. 2011).

Existing agriculture situation indicates that there is little scope for horizontal expansion of bringing land under cultivation. Saturation point has almost reached and hence an option left is for vertical intensification and diversification of agriculture. It is pointed out that the ability to achieve rapid economic growth in crop productivity and production output depends to a large extent on its ability to choose the best among the alternate paths available for maximization of agricultural products. Most specifically it must

economize on scares resources. There are many factors viz. introducing high yielding varieties of seeds, increasing the irrigation potential, recommended dose of manure and fertilizer, financial credit to the cultivators, none the less better prices and marketing facilities for agricultural commodities that can promote agricultural development. The adoption of better cropping optimally suited to the present day technological changes is also one of the path in augmenting the growth of agricultural productions.

Economic environment has changed considerably since independence through greater urbanization and planned development programmes of the nation. With the introduction of modern technology, high yielding variety, seeds, fertilizers, pesticides, labour saving devices and machines, improved cultural practices and additional irrigation facilities, the traditional equilibrium in agriculture is showing way to system of agriculture characterized by dynamic equilibrium. The relation between resources and products are changing. The marginal productivity analysis has gained the importance. Indian farmer who is much used to traditional farming, takes a long time to adjust with the scenario of changing environment.

Dry land cultivation is main stay in Indian agriculture. rainfed crops are at the mercy of nature and crop yield are subjected to violent fluctuations due to vagaries of mansoon and other unpredictable natural factors like temperature, humidity and wind velocity etc. About 66 per cent of the population in country is dependent on agriculture. Rural population is engaged in farming and its allied activities and as such their source of income is from agriculture. Agriculture, therefore, has immense role to play in the economy. The pace of economic development and raising the per capita income shall continue to influence significantly by the pace of agricultural development and its diversification.

Crop diversification is defined as diverting of sizeable areas from the existing cropping pattern to other crops and enterprises to meet the ever increasing demand for food, fodder, fibre and other needs. It can also be defined as producing increased variety of agricultural commodities

## 1.2 Importance of the Study

The study of diversification assumes a great significance as it is one of the important path for balanced development of agriculture to meet the human requirements. Diversification becomes necessary since cereals cannot alone support economic development not with standing the need to ensure food security. Diversification to commercial crops and minimize risk and earn foreign exchange. Diversification increased individual and social gains, helps in poverty alleviation, employment and environmental conservation. In the context of Indian agriculture, diversification has occurred across and with crops, livestock, horticultural sectors. Technological changes and government policies accelerate diversification to avoid monocropping.

Given the importance of crop diversification under changing scenarios, a study was undertaken to study the crop diversification with the following objectives.

## 1.3 Objectives of the Study

1) To examine the performance of major crops.
2) To study the changes in cropping pattern.
3) To study extent of crop diversification.
4) To study benefits of crop diversification.

## 1.4 Hypothesis

In overall period, cropping pattern of Akola district has changed.

## 1.5 Scope of study

The study of diversification help the farmers to improve the incomes, to provide gainful employment and to stabilize the income flow, diversification of crops emerges as a major strategy. Besides in several circumstances diversification is needed to restore the degraded natural resource base or to enhance the value of natural rasources. In several instances cropping systems have been diversified or new cropping systems have been introduced to retain or to enhance the value of natural resources principally land water. The diversification tends to stabilise farm income at a higher and higher level. It would help the small farmers who strive to make their farms viable.

CHAPTER II

# REVIEW OF LITERATURE

Several studies have been carried out in recent years to show changes in behaviour of cropping pattern in various states of India. In this chapter a review of relatively important studies relevant to the present analysis has been presented. A review of past research helps in identifying the conceptual and methodological issues relevant to the study. This would unable the researcher to collect accurate data and information and subject them to sound reasoning and meaningful interpretation keeping in view of objectives of the study reviews are presented under the following headings.

2.1 Performance of Major Crops

2.2 Changes in Cropping Pattern

2.3 Extent of Crop Diversification

2.4 Benefits of Crop Diversification

## 2.1 Performance of Major Crops

Shetty (1970) observed that the long term trend in agricultural production in India has been rising during the period 1920-21 to 1964-65. The trends in production of food grain and non food grain crops were also positive and significant through the rate of growth of the latter was twice as high as that of the farmer. At the all India level the acreage expansion was the important source of growth of production. The contribution of area accounted nearly 90 per cent of the increase in agriculture production. The contribution of change in cropping pattern to the growth of production was negligible.

Venkataramanan and Prahladachar (1980) estimated and analysed the growth rates in area, yield and output of major crops in six states including Maharashtra for the period 1950-51 to 1974-75. The results of the study showed that none of the crops in Maharashtra recorded significant growth rate in yields per hectare. A few of the crops registered negative growth rates in yield. The area growth rates for most of the crops were low, except sugarcane with 4.6 per cent area growth rate.

Desai and Patel (1983) studied growth rate of production, area and productivity of major food grain crops in the four states, viz., Gujarat, Madhya Pradesh, Maharashtra and Rajasthan of the western region of India. The growth rate of wheat for the period of 1965-66 to 1981-82 was much higher than that of rice in all the four states in the western zone. The highest growth rate was observed in Rajasthan followed by Maharashtra and Gujarat. However, Madhya Pradesh lagged much behind.

Alshi and Joshi (1984) worked on 'Measurement of Agricultural Growth in Vidarbha' for pre and post green revolution period from 1956-57 to 1966-67 and 1967-68 to 1979-80. The study revealed that the growth rate of area of jowar, wheat, total cereals, gram and total food grains were higher in post green revolution period than previous period. Growth rates of production of all the crops (except cotton) were positive and high in magnitude in post green revolution period as against negative growth rates in pre-green revolution period. the growth rate of productivity of all the crops were positive and high as against the growth rates in pre green revolution period in which productivity growth rates were negative (except wheat and gram). They have concluded that the production and productivity of important crops in Vidarbha increased during the post green revolution period. This was possible due to adoption of new technology during this period.

Arya and Rawat (1990) studied the district wise agricultural growth in Haryana for the period of 15 years (1966-67 to 1980-81). they have concluded that despite the inter state variation long terms trends of consistent increment in area, production and productivity growth were visible for wheat and rice among cereals and potato among commercial crops barring Rohtak and Gurgaon district where productivity growth for rice recorded negative and statistically non significant growth rates. Area, production and productivity growth rates for commercial crops including oil seeds, sugarcane and cotton had registered increase in certain districts. the results showed that crops like bajra, jowar, maize, barley and pulses in general have registered declining trends in the districts.

Mitra (1990) made an attempt to examine the growth of agricultural production in Maharashtra and its four regions for the period 1956-57 to 1984-85. The entire period of the study has been divided in to two sub periods for estimation the growth rates of area, production and yield of major crops. The author stated that annual compound rate of growth of agricultural production in the state as well as in all the regions specially that of food grains was relatively higher in twelve year period ending 1984-85, after a near stagnancy in sixteen year period ending 1971-72. The overall rate for the growth of production of food grain was around 2 per cent per annum which has been mainly brought about by growth in yield. Amongst cereals the rate of growth in yield of wheat is not of much higher order than those of other cereals. Jowar, pulses also show a very slow overall rate of growth in production brought about by equally marginal rate of growth in area and yield. Comparatively Nagpur region showed a better performance mainly because of good performance under jowar. Groundnut and cotton did not show any significant overall growth in production. The overall growth of area under these two crops was negative

and there was marginal increase in the rate of growth of yield for these crops.

Mundinamani *et al.* (1995) examined the growth performance of groundnut, sunflower, safflower and sesamum for the selected districts of Karnataka and the state as whole. The study was conducted for the period from 1955-56 to 1989-90. Growth rates were computed for two sub-periods namely pre-green revolution period (1955-56 to 1965-66) and post green revolution period (1966-67 to 1989-90). They have fitted the exponential function i.e. $Y_t = a \cdot b^t$ for the analysis. The results of the study showed that the growth in production was achieved mainly due to expansion of acreage in the study area and to some extent by yield effect in the recent years. the improvement in yields was observed in areas where irrigation facilities were extended. They have stated that the potentiality of the viable technology developed for major oil seeds was not yet made a significant impact in increasing oil seeds productivity.

Jahagirdar and Ratanlikar (1996) studied the district wise growth rates of area production and yield of *kharif* jowar in Maharashtra. The study covered the period of 30 years i.e. from 1960-61 to 1989-90. The entire period of study was divided in to three periods namely a) pre-green revolution period (1960-61 to 1969-70) b) green revolution period (1970-71 to 1979-80) and c) post green revolution period. (1980-81 to 1989-90). The authors concluded that during the period of technological break through a consistent and positive growth has been observed in area, production and yield. The compound growth rate of area indicated declining and inconsistent area allocation during the decade. Undesirable trends in area production and yield were observed in some of the districts.

Kalyankar and Ghulghule (1997) examined the growth in the productivity of major crops among different divisions of the Maharashtra

state for the period from 1961 to 1964. They showed that the per hectare productivity of paddy crop was comparatively higher in Kokan and Kolhapur division of western Maharashtra. The growth rates of total cereals productivity were highest in Amravati division followed by Kolhapur division. Similarly higher growth rates were observed for productivity of total pulses in Nashik division while total oil seed productivity increase with higher rate of growth in Nagpur division. Growth rates for productivity of cotton were higher than the state growth rate in Nagpur, Amravati, Aurangabad, Kolhapur and Pune divisions.

Marawar *et al.* (2004) examined the performance of oil seeds in different districts of Vidarbha for the period from 1980-81 to 2001-02. The study revealed that area under kharif groundnut decreased over the period of study in Vidarbha whereas summer groundnut showed mixed trends. The area under sunflower and soybean was increased significantly in all the districts of Vidarbha. In general the area under total oil seed was increased significantly. The production of kharif groundnut decreased over the year of study but the production of sunflower, summer groundnut, safflower and soybean increased significantly. The productivity of sunflower was more or less stagnant over the study period. During the study period the productivity of safflower decreased at a growth rate of 1.80 per cent in Vidarbha.

Singh *et al.* (2007) made an attempt to study trends, growth rates and contribution of area, production and productivity and their interaction to be chickpea production in different major pulse producing zones during the last 30 years i.e., from 1975-76 to 2004-2005 and it was observed that during the period country as a whole observed declining trend in both area and production. However, increasing trend in productivity

from 707 to 844 kg/ha was observed overall chickpea production was increased due to increase in productivity.

## 2.2 Changes in Cropping Pattern

Gupta (1963) studied the interstate differences in cropping pattern and productivity for the period 1949-50 to 1958-59. The result of the study indicated that the relative importance of area devoted under cereal farming has declined whereas that of cash crop has increased. Among the cereals, the most spectacular decline, occurred in the case of rice, but the importance of wheat and maize has increased. A shift has taken place not only in between important cereals and other crops but within the cereal group also. the important fact of the study was that rice being the most high yielding crop and also commands most important position, showing a tendency to decline in importance.

Johl and Kahlon (1963) studied the economics of cropping pattern in Ludhiana Development Block of the Intensive Agricultural District programme (Punjab) to suggest some suitable cropping pattern for this area by method of linear programming. The normative cropping pattern obtained in this process envisaged a shift from rabi to kharif crops to an extent of 9.94 per cent of the cropped area. In rabi season there was a little shift from wheat to gram. In kharif season maize acreage remained almost unchanged. Desi cotton was substituted by American cotton and the acreage under groundnut increased from 0.91 acres to 2.12 acres. The results, thus demonstrated that there was a great scope for increasing intensity of cropping and levels of income by making rational adjustments in the existing resource use and cropping pattern of the area under study.

Singh *et al.* (1970) examined the changes in cropping pattern in Narmada basin for two periods i.e. 1955-56 to 1959-60 and 1960-61 to

1964-65. There were 20 districts in Narmada basin which have been classified in four zones. The study revealed that, there was a tendency for a shift of area from food crop to non food crops. This was seen in 13 districts. Out of 20 districts in the basin. The major beneficiary of this shift was oilseeds group, though fibres showed some increase.

Dikshit and Singh (1974) studied changing cropping pattern and its determinants in Uttar Pradesh during the decade 1960-61. They have took three yearly averages centered around the year 1961-62 and 1969-70. It was observed that the acreage under wheat, maize, bajara, paddy, groundnut and rapeseed had increased while the acreage under jowar, barley, gram, peas, arhar, sugarcane and other crops had declined. Changes in the cropping pattern have been explained in terms of profitability (price x yield) price, yield, net area irrigated and relative profitability. The relationship have been tested by calculating lagged coefficient of correlation. The nature and strength of the relationship varied from crop to crop. both wheat and maize showed a positive and statistically significant relationship with all the variables. High positive response to price was noted in the case of wheat, sugarcane, maize, groundnut and rapeseed. Price response was however, negative in case of gram, barley and arhar. High association between area and price of a number of crops suggested that price policy could be used as powerful instrument for crop planning in the state.

Bhadauria *et al.* (1978) examined the changes in cropping pattern and productivity in Himachal Pradesh for the period 1951-52 to 1975-76 by fitting linear trends. For comparative view of the pre-green revolution and the post-green revolution period. The entire period of study was divided in to two sub periods viz., i) 1951-52 to 1965-66 and ii) 1966-67 to 1975-76. Eleven important crops which covered about 90-92 per cent

for the total crop area were selected for the study. On the basis of the study the author concluded that allocation of area between food crops and non food crops has almost been rigid with a marginal shift in favour of food crops. Wheat and maize remained to be the most important crops throughout the period. Cultivation of cash crops like ginger, potato and apple increase tremendously in both period while proportionate, share of area but not absolute area under tea has gone down in the pre-green revolution period. The trend values for rice, barley and millets were negative in both the periods. During the post-green revolution period, the yield trends were comparatively higher and the benefits of new technology have been well spread over all the crops.

Sridharan and Radhakrishnan (1978) studied the changes in cropping pattern in Nilgiri district. The study covered a period of ten years from 1966-67 to 1976-77. The study revealed that the acreage allocation between the crops was influenced by physical, economical, biological and social factors. In order to test the shifts in cropping pattern between each pair of years Kendalls rank correlation coefficient was used. Ranks were assigned to each crop on the basis of its percentage to total cropped area. All correlation coefficients were found to be significant at one per cent level of significance. Which indicated that there was no shift in the cropping pattern between each pair of year. The total change over during entire period under study was examined through concordance coefficient and its significance showed that there was no significant shift in the cropping pattern over the entire period.

Venkataramanan and Pralhadachar (1980) examined cropping pattern changes in Maharashtra for the period 1950-1975. They have concluded that during 25 years period under review gross cropped area in Maharashtra increased by 3.30 lakh hectares from 177 lakh

hectares in the 1950-55 to 196.3 lakh hectares in the 1970-75. The bulk of this overall increase in gross cropped area was due to the extension of net cultivated area in the state. The crops which were benefited by the increase in the gross cropped area in the state during the reference period were jowar, cotton, rice, wheat, sugarcane, total pulses and bajra. Even though increase in area under these crop took place there were no significant changes in their relative shares in the cropping pattern. The cropping pattern in the state remained stable over the entire period.

Johl and Sidhu (1988) studied changes in cropping pattern in different states and country as a whole in the triennium ending 1984-85 over the triennium ending 1972-73. They have showed that for the country as a whole, area under coarse cereals decreased by 3.85 per cent. rabi pulses by 0.78 per cent and cotton by 0.33 per cent over base period. As against this, the area under wheat increased by 2.03 per cent and rice by 0.04 per cent. The coarse cereals were replaced at the margin by fine cereals. A significant feature, was that area under total cereals declined by 1.78 per cent and this area was shifted to kharif pulses, sugarcane and oilseeds. In the same study the authors showed that the area under other cereals declined by 7.96 per cent while in Maharashtra area under pulses increased by 1.79 per cent.

Tripathy and Gowada (1999) made an attempt to apply markov chain analysis to study the structural changes in cropping pattern in Orissa by using macro data of crop proportion for the period of 1975-76 to 1989-90. They have used the data of proportion of area under six crops i.e. rice, coarse cereals, pulses, oilseeds, vegetables and fruit and other crops. They have described the processes of cropping pattern change in the form of a matrix P of first order transition probabilities. The study indicated that rice and pulses were most stable crops in the state. After introduction of

new crop production technologies there has been structural change in cropping pattern of the state. Study reveals that the area under rice major and staple food crop of the people had shown a decreasing trend.

Kumar and Mittal (2003) examined changes in cropping pattern (crop diversification) that took place in various states of India in three decades during 1970's, 1980's and 1990's and measures the aggregate changes in cropping pattern in terms of substitution and expansion effects. They also examined the degree of crop diversification in various farm size groups. They concluded that the changes in cropping pattern have been taking place as a result of substitution from low productivity crops to high productivity crops, some of these crops are paddy, wheat, maize groundnut. rapeseed, mustard and sugarcane. Coarse cereals and pulses have shown a study decline in the area. Regional pattern in crop specialization is increasing. They have stated that the small farms practiced multi-diversified farming and grow a number of crops even on fragmented plots, involving allocation of area under seasonal fruits, vegetables, etc. for maximizing their household income and employment in almost all regions of the country.

## 2.3 Extent of Crop Diversification

Gupta and Tewari (1985) examined the empirical relationship between crop diversification and selected socio-economic variable in three tracts of Allahabad district in Uttar Pradesh for the year 1981-82. They have used different measures of crop diversification defined both an acreage and net crop income proportion. They observed that larger farms is relatively less diversified. Tenancy (cash renting) discouraged diversification. Farms with higher irrigation intensity and located nearer to market were relatively more diversified. Relatively more crop diversification was observed on the farms which perceive greater business risk practice.

Share cropping and family size did not affect the level of crop diversification.

Pal and Pal (1985) observed crop diversification, its causes and impacts on the farm economy of West Bengal for the period 1972-73 to 1978-79. They stated that at the farm level diversification take place in the form of wider varieties of crops called crop diversification (D) and or in the form of new varieties of old crops called variety diversification (VD). Entropy analysis entails that farms in general have increasingly practiced both CD and VD in their farm activities. They concluded that the mode of farming, the degree of mechanization and the farm size have been effective in enhancing diversification. Diversification is more pronounced in the capitalist forms than in the peasant farms. Small farms were more crop diversified than medium and large farms.

Singh *et al.* (1985) studied the diversification of Punjab agriculture by using Herfindahl and Entropy index. They observed that increase in Herfindahl index showed continuous decrease in diversification over the years of study period (1965-66 to 1983-84). The crop economy of Punjab has been getting oriented towards paddy-wheat rotation. Entropy I was calculated for all possible 20 crops. Entropy II and III were calculated for five and four crop groups, respectively. A gradual decline in Entropy I, II and III over the years also confirms the study decrease in diversification. The entropy index of diversification based on 20 crops declined by 18.41 per cent over the period 1965-66 to 1983-84 while the Entrophy III index based on four commodity groups declined by 19.95 per cent over the same period. However, the Entropy II index based on five commodity groups declined the sharpest i.e. by 26.01 per cent. The paddy-wheat rotation has been of critical importance in declining diversification or increasing specialization in crop farming.

Chand *et al.* (1986) studied the diversification of agriculture in Himachal Pradesh for the period 1971-72 and 1981-82. They used Gibbs martin method for computing the diversification indices. They concluded that the agricultural diversification was of complex nature in Himachal Pradesh due to variation in agro-climate conditions between different regions. Diversification had taken place at all levels, but it appeared to have benefited more the districts falling in mid and higher hills, as also the medium and large farmers.

Bhatia and Tewari (1990) studied diversification growth and stability of agricultural economy in U.P. for the period of 14 years from 1970-71 to 1983-84. They used two measures of diversification i.e. Herifidahl index and Entropy index defined on acreage and income proportions. Both the crop diversification measures were estimated for each district at three points of time i.e. 1970-71, 1976-77 and 1980-81. They concluded that the U.P. economy is undergoing gradual diversification in favour of secondary and tertiary sectors which is a healthy sign of economic development. The contribution of forestry and logging sub-sector seems to be almost falling. Availability of irrigation water all around the year in a district is expected to promote diversification. Higher nitrogen distribution/ consumption in a district and increase in percentage of tenants promoted specialization. Draft force whether it is through tractor or draft animals promotes specialization. Milch animals have positive influence of diversification. Agricultural business risk showed negative and significant effect on crop diversification.

Haffis *et al.* (1990) studied diversification of cropping systems and its economics of Chevella watershed in Medak district of Andhra Pradesh and Mittemari watershed in Kolar district of Karnataka for the period 1984-85. through 1987-88 for 10 major crops. They applied Gibbs Martion model to measure the indices of crop diversification. The study

revealed that watershed management at Chevall and Mittemari had made a clear impact on crop diversification which had become the kingpin in stabilizing the farm returns of dry land farmers in addition to minimizing the risks involved in dryland agriculture in these regions. Authors reported that chevell watershed area had very high (88) level of diversification during 1985-86 to 1986-87. While, Mittemuri watershed villages had (75) level of diversification in the year 1986-87. The pattern of diversification during 1987-88 indicates that the index of diversification under Chevell watershed management is convincingly established very high level of diversification.

Arora and Srivastava (1996) studied diversification of cropping pattern and food grain mix in India for the period from 1950-51 to 1994-95. They used modified Herfindahl index as a measure of diversification. They observed that the level of diversification of cropping pattern showed a significantly declining trend during the period of study. During the pre-green revolution period, the change in diversification though positive, was found non-significant. After the advent of green revolution particularly during its early phase (1967-81), there has been a negative and significant decline in the level of diversification. The shift of area from coarse cereals and pulses to wheat was particularly responsible for the same. The impact of new economic policy having thrust on commerciallisation, liberalization and globalisation, appears to be direct as the trend of diversification become positive during the 1990's. The trend in diversification of Indian food basket is found to be negative (and significant too) in all periods, pre-green revolution and later phase of the post-green revolution period.

Khatkar *et al.* (1996) studied the factors affecting diversification of agriculture in Hisar district of Haryana for the year 1994-95. They observed that more than 50 per cent of the respondents reported high risk in new enterprises, heavy initial investment, perishable nature of

products, lack of finance, lack of marketing and processing, infrastructure and religious/ social convictions as the major constraints hindering the diversification of agriculture towards other commercial enterprises. The empirical analysis of three major measures of diversification viz., index of maximum proportion (D1), Herfindhahl index (D2) and Entropy index (D3) indicated good amount of diversification of crop enterprises in the study area. The values of D1, D2 and D3 ranged from 0.21 to 0.49 from 0.16 to 0.43 and from 0.41 to 0.88, respectively.

Pandey and Sharma (1996) studied crop diversification and self sufficiency in food grains of country. To examine crop diversification in the country, the Herfindahl index was worked out for each year from 1970-71 to 1994-95. Then to facilitate direct interpretation, crop diversification index (CDI) was calculated as one minus Herfindahl index. To study the change in diversification over time, simple linear trend equation was estimated for crop diversification. Index for the period from 1970-71 to 1994-95. The study revealed that a high level of diversification among all crops as well as within food grains and non food grains was found. However, the extent of diversification is found to be declining over time among the food grains, as revealed by highly significant negative trend coefficients for CDI-1 and CDI-2. On the other hand, a significant positive trend is being observed in CDI-3 indicating increasing diversification over time among the non-food grains.

Saraswat (1996) studied the diversification in cropping pattern and farming system of Kot village of Hamirpur district in Himachal Pradesh for the year 1959-60 to 1989-90. The study revealed that the change in the cropping pattern of Kot village was marginal because of lack of irrigation facilities and due to the reason that some crops were eliminated and some other crops were introduced but all are dry land crops. The diversification in agriculture took place due to increasing trend of agricultural productivity

because of the technical changes i.e. use of high yielding variety (HYv) seeds, fertilizers, pesticides and improved methods of cultivation in agriculture.

Sharma *et al.* ((1996) studied crop diversification and food security in major State of India for the period 1980-81 to 1991-92. The diversification indices have been calculated through Herfindahl index. They observed that the percentage of area under cereals has been decreasing over the decade. The percentage of area under cereals was more than 90 per cent in Himachal Pradesh and Jammu and Kashmir where as it was the lowest in Kerala. However, the diversification was found to be low in Kerala as indicated by comparatively high value of Herfindahl index. The diversification was found to be high in Andhra Pradesh, Karnataka and Maharashtra. The factors affecting diversification indicated that size of holding had positive relationship with diversification. The study revealed that there is substantial scope for increasing the degree of diversification without adversely affecting food security for the nation as a whole.

Singh *et al.* (1996) studied the trends in diversification of Punjab agriculture during the period 1965-66 to 1992-93. The study revealed that the Punjab economy is under going gradual diversification in favour of secondary and tertiary sectors while the cropping pattern is getting gradually specialized towards cereals, particularly rice and wheat as measured by both Herfindahl and Entropy indices. The factors affecting diversification at the macro level revealed that diversification based on Herfindahl index was positively affected by fertilizer consumption, standard deviation of per hectare value productivity, tractor density and net sown area per agricultural workers and negatively and significantly affected by market density, quantum and assuredness of irrigation. At the micro level diversification was found to be inversely related to farm size, distance from

the market, assets per hectare and family labour both in the Central plain and South-Western regions.

Singhal and Gouraha (1997) studied the extent of crop diversity shift in different eco-systems and the various factors responsible for crop diversification during the period 1979-80 to 1993-94 in Madhya Pradesh. Crop diversification measures, namely, Herfindahl and Entropy indices were calculated using proportionate area under various crops for different periods (Period I - 1979-80 to 1981-82, Period II 1985-86 to 1987-88 and Period III - 1991-92 to 1994-95) to study the trend of crop diversification. The regression analysis was done to assess the contribution of various economic variables to crop diversification. The study revealed that the crop diversification has an uneven trend over different periods of time within various groups of crops in canal irrigated non-tribal districts. Relatively rainfed tribal and non-tribal districts of Chattisgarh region have maintained the level of crop diversity between different groups of crops. Extension in canal irrigated area brings out crop specialization in the tribal district too. In Chattisgarh region the analysis of Herfindahl measures showed crop specialization in general. In between most of the groups gradual crop diversification is reported. Entropy measures analysis confirms that paddy and lathyrus as independent crop groups leads to crop specialization. The major factors affecting crop diversification at the macro level are rainfall and per cent irrigated area by canal in positive direction. The percentage of gross irrigated cropped area is reported to be another positive significant factor of crop diversification.

Singh (1999) studied the potential of diversification towards high value crops in Maharashtra for three zones namely Akola, Pune and Maharashtra for the agricultural year 1996-97. Herfindahl index and Entropy index were used to measure crop diversification level. He observed that in general food grains accounted for about 30 per cent of the gross

cropped area, followed by cash crop with 30 per cent, vegetables about 16 per cent and fruits 12 per cent. Farmers growing food grains, cash crops, vegetable crops and were putting large portion of the gross cropped area under food grain and cash crops mainly to ensure food security and availability of cash. The Herfindahl index ranged from 0.207 for food grains, cash crops, vegetable and other crops scenario whereas about seven crops were grown to 0.361 to food grains and vegetable crop scenario where about three crop were grown. He concluded that farmers were practicing diversification. The scope for diversification of food grain with vegetable, fruits and flower was observed to be vast both in terms of farm profitability and employment of labour.

Uptal Kumar De (2000) examining the levels of crop diversification in different districts of West Bengal during 1970-71 to 1994-95. Triennia average of area under crops has been calculated for the periods 1970-73, 1977-80, 1984-87 and 1991-94. The different crops diversification indices have been calculated from triennia average data to know the level of concentration or diversification at different points of time and their change over the year. The author concluded that there exists wide spatio temporal variations in the acreage allocation under different crops. In general there has been a movements towards more commercial crops. The author suggested that the study of crop diversification may be utilized to find out its contribution to the changing income and also to examine its long term impact on the resource base viz., productivity of land, use of other resources, etc.

Joshi *et al.* (2004) studied the status of Agricultural diversification is South Asian Countries for a period of two decades from 1980-81 to 1999-2000. For assessing the extent of diversity in crop, livestock and fisheries activities, they used Simpson index. The results of the study revealed that agricultural Sector in South Asia is gradually

diversifying in favour of high value commodities namely fruits, vegetables, livestock and fish products. Much of the diversification came, if at all, with only little support from the governments. Despite fousing effects towards food grain production in South Asian Countries, a silent revolution is witnessed in high-value commodities. The author reported that production of fruits, vegetables, livestock and fish products have increased remarkably in most of the South Asian Countries. During 1980's production increase was attributed to the rise in their yield levels. During 1990's production increase came from area augmentation. In Indian Context the key determinants for high value commodities (Horticultural and Livestock) were markets and roads and were influencing the status of diversification other important determinant was the technology absorption in the region. Higher the technology adopting of cereals (particularly irrigation) less was the diversification in favour of high value commodities. Diversification in favour of horticultural and livestock commodities was more pronounced in rainfed areas which was by passed during the green revolution but now could take advantage of agricultural diversification. The rainfed areas were becoming a hub of non cereals due to their low water requirement and abundant labour supply. Besides, relative profitability of high value commodities in relation to other crops also played important role in determining status of diversification.

Prahadeeswaran *et al.* (2009) studied changing pattern of crop diversification and Evidences for commercialization of Agriculture. There are several indices, which explain either concentration or diversification of activities in given time and space by a single quantitative indicator. Important indices used to study the crop diversification are Herfindahl Index (HI), Simpson Index (SI), Ogive Index (OI), Entropy Index (EI), Modified Entropy Index (MEI) and Composite Entropy Index (CEI). Shiyani and Pandya (1998) and Sundaresan *et al.* (2002) had applied more

than one of the above indices to study the diversification of agriculture in Gujarat and Coastal districts of Tamil Nadu, respectively.

### 2.4 Benefits of Crop Diversification

Agrawal (1958) studied the economics of farm management in U.P. The investigation was conducted on 600 randomly selected farms in two district of Western U.P. for three years 1954-57 and 200 of them by the cost accounting and the remaining 400 by the survey method. The low ratio of output to input i.e. 1.2. for all the farms was observed. It was observed that the output-input ratio increases in general with the increase in the size of farms. He also observed the value of output per acre was rather higher in the lower size groups as compared with the higher size groups. This was mainly due to a higher intensity of cropping on smaller farms. But output-input ratio was more favourable on larger farms, because of corresponding greater reduction in the cost of input factors per acre.

Garg (1985) examined economics of production of soybean in Madhya Pradesh and Uttar Pradesh. He observed that the per hectare cost increased on soybean cultivation was Rs. 2225/- while total return was Rs. 2875/-. Returns per rupee invested were worked out to Rs. 2.14. The average yield obtained was 16 q/ha.

Singh and Attibudhi (1985) studied economics of pulse cultivation. They found that per hectare cost of production in small and large farms were Rs. 613.13 and Rs. 704.68 respectively. It was observed that human labour, bullock labour and seed contribute major proportion of total cost. Human labour accounted highest share of about 25 and 25 per cent of total cost (per ha) in two farm sizes respectively. Bullock labour and fertilizers accounted for 14 per cent and seed about 12 per cent of total cost of production, manures and fertilizers are accounted about 14.4 per cent and 16 per cent respectively on the two farms categories.

Gadre and Mahalle (1988) studied comparative economics of production of different crops in Vidarbha region during 1985-86 and 1986-87. The cost of cultivation per hectare worked out to Rs. 3848 for hybrid cotton, followed by mung safflower crop sequence and tur crops. The same for desi hybrid cotton, mung-gram sequence and mung-wheat sequence worked out to Rs. 1541, Rs. 1495 and Rs. 1404 respectively. Measuring the profitability of different cropping systems on the basis of net returns per hectare, tur gave the highest per hectare net returns followed by mung-safflower, mung-gram.

Singh and Rizvi (1988) studied the comparative economics of production, cost of production, input-output ratios and returns from soybean and its competing crops in Uttar Pradesh. The reference period of study was the agricultural year 1986-87. Soybean was a profitable kharif cash crops in Jalaun district because its average cost of production per quintal has been the lowest at Rs. 142 as compared to other kharif crops. Nainital district the average cost of production was higher at Rs. 175 per quintal in the case of soybean as compared to paddy, maize and urid. Input-output ratio of soybean in both the district suggests a high potential for increasing farm income.

Vitonde and Koranne (1990) studied comparative economics of high yielding improved varieties of cotton in Nagpur district. They observed that 60-70 per cent of cultivators of small and medium groups obtained 5 to 10 quintals per hectare and spend Rs. 3000 to 5000 per hectare. About 40 to 50 per cent of cultivators in small, medium and large holding group had obtained net returns of Rs. 100 to 1000 per hectare while 20 to 30 per cent cultivators had obtained net returns between Rs. 1000 to 5000 net income per hectare.

Shete *et al.* (1992) examined the resource use and input-out relationship of mixed and arable farming in Ahmednagar district of Maharashtra. The study was undertaken in 12 village of Ahmednagar district. In all there were 120 sample, 60 of mixed, 30 of each irrigated and unirrigated region and remaining 30 were arable farms. They concluded that the use of all resources was higher on mixed farms compared to arable farms in both the irrigated and unirrigated regions. In mixed farms of irrigated regions total value of output increased with increases in gross cropped area and human labour, while it decreased with expenses on livestock.

Acharya (1994) computed agricultural incomes of farmers and their distribution. Cultivators earning per hectare of sorghum was Rs. 729.29, for cotton Rs. 913 and mung Rs. 573.47. Coarse grains like bajara, jowar, yielded uniformly agricultural labours. This was due to variation on crop yield, monsoon uncertainly, local price variations. Income of cultivators are generated by set of factors that relates to productivity and productivity and product market condition under assumption of positive returns at individual factor production. If there was high input use like fertilizer, manure, irrigation, improved seeds, etc. The rate of returns to cultivators should be high. This is true particularly for India where much of land is rainfed and soil nutrient application is much low in most areas.

Pawar *et al.* ( 2000) conducted the study in Satara district of Maharashtra to find out the productivity attained on the small farms (22.25 q/ha). The per hectare cost of cultivation was Rs. 22,000 and Rs. 11,242 respectively. Input-output to 1:1.97 which indicates that soybean production economically a viable proportion.

Ramsundaram and Gajbhiye (2001) studied economic analysis of cotton cultivation in two ecosystems i.e. irrigated

(Shriganganagar) and rainfed (Amravati). Return over variable cost was maximum in American irrigated cotton i.e. Rs. 13903 followed by desi irrigated cotton to Rs. 6346. Input-output ratio were 1:2.12 and 1:1.72 in American and deshi irrigated cotton respectively. In rainfed hybrid variety average yield was 3.78 qtls. per hectare with gross income of Rs. 7938. Input-output ratio for hybrid of rainfed cotton was 1:1.72 and for LRA 5166 it was 1:1.41.

Takashi Kurosaki (2003) studied the economics of crop diversification. In which he concluded that in order to examine the benefits of diversification, land concentration ratio in tahsils with comparative advantage is computed for selected years. The comparative advantage is approximated by the per acre gross revenue of each crop relative to the average revenue of the remaining crops. If the ratio for a crop increases over the time, it implies that area under the crop is being concentrated in tahsils that have comparative advantage in producing a crop over other crops.

## CHAPTER III

# METHODOLOGY

In any scientific study, it is necessary for investigator to get well acquainted with the method of conducting research and follow appropriate steps in carrying out research to get desired results. In the field of research in agricultural economics, the steps involved are selection of research topic, formulation of objectives, nature and source of data to be collected, deciding methods of collection of data and analysis of data. The methodology adopted for present study is discussed briefly in this chapter.

### 3.1 Selection of Area

The study has been confined to the Akola district of Vidarbha region of Maharashtra State. These tahsils namely Akot, Balapur, Murtijapur and Patur were selected purposively for study.

### 3.2 Selection of Crops

For the present study, the major crops namely Cotton, Soybean, Wheat, Kharif Jawar, Tur and Gram were selected. These six crops occupied more than 80 per cent of the gross cropped area in the tahsils. Thus, study was confined to major crops with an assumption that excluded crops do not affect cropping pattern and in turn would not vitiate main conclusions of the study.

### 3.3 Collection of Data

The study was based on secondary data. The secondary data on the area, production, productivity of selected crops, of Akola district were collected from 1995-96 to 2009-10.

1) District Superintendent Agriculture Office (DSAO) Akola.

2) For estimating the Benifits of crop diversification of selected crops data was collected from Agricultural Prices and Costs Scheme (APC) functioning in the Department of Agricultural Economics and Statistics, Dr. PDKV, Akola.

### 3.4 Analytical Tools and Techniques

The methods of analysis adopted in the present study are elaborated under the following headings.

#### 3.4.1 Analysis of examination of the performance of major crops

1) For examining performance of different crops growth rates of area, production and productivity were estimated using exponential model.

$$Y = ab^t$$

where,

Y = area, production, yield
a & b = are the parameters to be estimated from exponential model
CGR = [Antilog (log b) -1] x 100

2) Coefficient of Variation (C.V.)

Coefficient of variation of area, production and yield were calculated by using following formula.

$$C.V. = \frac{S.D.}{Mean} \times 100$$

#### 3.4.2 Analysis of changes of cropping pattern

Cropping pattern refers to distribution of the acreages expressed as a percentage of the gross cropped area under different crops. The data on cropping pattern at different point of time collected from the District Supritendant Agriculture Office (DSAO).

The entire study was spilt in to four sub-periods. The sub-period formed was as below,

Period I : 1995-96

Period II : 2000-01

Period III : 2005-06

Period IV : 2009-10

### 3.4.3 Analysis for extent of crop diversification

The extent of crop diversification were studied by using Herfindahl index and Entropy index. These indices are calculated for each five year time period from 1995-96 to 2009-10 for each tahsil of Akola district. Shiyani and Pandy (1998) also have used similar indices to study the diversification of agriculture in Gujrat state, India. The indices is defined as below.

**a) Herfindahl Index (HI)**

Herfindahl index (HI) was computed by taking sum of squares of acreage proportion of each crop to the total cropped area.

$$HI = \sum_{i=1}^{N} Pi^2$$

where,

N = The total number of crops

Pi = Proportion of acreage under $i^{th}$ crop to total cropped area

The value of HI is bounded by zero (perfect diversification) and one (complete specification). The value of HI approaches zero as 'N' becomes large and takes value one when only one crop is cultivated.

**b) Entropy Index (EI)**

It is calculated as,

$$EI = \sum_{i=1}^{N} \left\{ Pi \log \left( \frac{1}{pi} \right) \right\}$$

The index tends to zero when there is a perfect concentration and the value increases with the increase in diversification of crop. If values

lies between zero and log N then the upper limit of this index depends on the base of logarithm and the number of crops.

### 3.4.4 Analysis of benefits of crop diversification

One of the way to study the pattern of concentration of land among the cultivating crop is to find out the relative contribution of each crop among the remaining crop.

In order to examine the benefits of diversification, land concentration ratio in selected tahsils with comparative advantages was computed for selected period i.e. from 2001 to 2009-10. The comparative advantage is here approximated by the per acre gross revenue of each crop relative to the average revenue of the remaining crops (Takashi Kurosaki, 2003).

Higher land concentration ratio are associated with higher proportion of area under particular crop and vice-versa.

## CHAPTER IV

# SOCIO-ECONOMIC STATUS OF AKOLA DISTRICT

This chapter specifies the brief survey of the important agro-economic features of Akola district therefore and attempt was made to study to agroclimatic condition of the area selected for the study. This chapter presents agroeconomic characteristic of the study area.

### 4.1 Location of Akola District

Akola district falls under Vidarbha region of Maharashtra. It comprises of seven tahsils. It lies between 20° 17' and 21° 18' North latitudes and 76° 17' and 77° 14' East longitudes. It covers area of 5417 sq. km. accounting for 1.76 per cent of the total area of Maharashtra. Akola district is surrounded by Amravati district in North, part of Amravati and Yavtmal district in East, Washim and Yavtmal district to the South and Buldhana district towards the west.

### 4.2 Topography and Soil

The northern part of the Akola district lies in Purna valley which itself is a part of Tapi river basin. River Purna has formed fertile basin in Akola, Balapur and Murtizapur tahsils of Akola. Akola district divided into seven tahsils for smooth administration. The district ranks fourth in respect of size and fifth in respect of population among the 11 districts of Vidarbha region of Maharashtra. The soil of the district is basically derived from volcanic trap rock and it is quite fertile. It is classified into categories as coarse soil found in south, medium black soil found in the plain and deep black soil found in river valley.


**Fig. 1. Map of Akola district**

## 4.3 Climate and Rainfall

Being away from the sea, the district experiences the extremities of climate. The weather during winter is too cool, while in summer it is too hot. The average minimum and maximum temperature extremities observed throughout the year were 10°C and 46.5°C, respectively. Akola district falls in assured rainfall zone of Maharashtra state having average rainfall between 750 to 1000 mm.

## 4.4 Demographic Features

### 4.4.1 Population

The important demographic features of the district as per official census 2011 in comparison with the 2001 census are presented in Table 4.1.

**Table 4.1. Demographic particulars of Akola district**

| Sr. No. | Particulars | Census 2011 | Census 2001 |
|---|---|---|---|
| 1. | Actual population | 18,18,617 | 16,30,239 |
| 2. | Male | 9,36,226 | 8,41,253 |
| 3. | Female | 8,82,391 | 7,88,986 |
| 4. | Population growth | 11.60% | 20.58% |
| 5. | Area Sq.Km | 5673 | 5673 |
| 6. | Density/Km | 321 | 287 |
| 7. | Proposition to state population | 1.62% | 1.68% |
| 8. | Sex ratio (per 1000) | 942 | 938 |
| 9. | Child sex ratio (0-6 age) | 900 | 933 |
| 10. | Total child population (0-6 age) | 2,06,053 | 2,35,835 |
| 11. | Male population (0-6 age) | 1,08,425 | 1,22,004 |
| 12. | Female population (0-6 age) | 97,628 | 1,13,831 |
| 13. | Average literacy | 87.55 | 81.42 |
| 14. | Male literacy | 92.89 | 88.91 |
| 15. | Female literacy | 81.91 | 73.44 |

(Source : Directorate of census operations in Maharashtra,2011)

The district population was 18,18,617 which constitute about 1.62 per cent of state population. Out of the total population 9,36,226 (51.48 %) were males and 8,82,391(48.52 %) were females. The sex ratio was 942 females for every 1000 males. The density of the population for the district was 321 persons per sq. km. The population growth was recorded at 11.60 per cent when compared to 2001 census which was 20.58 per cent.

Out of the total population 39.69 per cent of the population in the district i.e., 7, 21,849 were living in urban areas where as 60.31 per cent i.e., 10,96,768 in rural areas. In rural area male population constitute of 5,66,172 were as female population constitute of 5,30,596. Regarding population in urban areas 3,70,054 constitute male and 3,51,795 are female. Sex ratio was found to be 937 (for 1000) in rural areas and 951 in urban areas respectively. The features are presented in Table 4.2.

**Table 4.2. Features of rural and urban areas in Akola District**

| Sr. No. | Particulars | Rural | Urban |
|---|---|---|---|
| 1. | Population (%) | 60.31% | 39.69% |
| 2. | Total population | 10,96,768 | 7,21,849 |
| 3. | Male population | 5,66,172 | 3,70,054 |
| 4. | Female population | 5,30,596 | 3,51,795 |
| 5. | Sex ratio (per 1000) | 937 | 951 |
| 6. | Child sex ratio (0-6 age) | 907 | 890 |
| 7. | Total child population(0-6 age) | 1,25,698 | 80,355 |
| 8. | Male child population | 65,913 | 42,512 |
| 9. | Female child population | 59,785 | 37,843 |

(Source: Directorate of census operations in Maharashtra,2011)

### 4.4.2 Literacy Status

Among the total population, 14,11,747 were literates of which 7,68,925 were male literates and 6,42,822 were female literates. The literacy rate was 92.89 per cent among males and 81.91 per cent among female population in the district. The average literacy rate was 87.55 per cent. The details of literacy pertaining to district are presented in Table 4.3.

**Table 4.3. Literacy status in Akola district**

| Sr. No. | Particulars | Actual population | No. of literates | % to total |
|---|---|---|---|---|
| 1. | Male | 9,36,226 | 7,68,925 | 42.28 |
| 2. | Female | 8,82,391 | 6,42,822 | 35.34 |
| | **Total** | **18,18,617** | **14,11,747** | **77.62** |

(Source: Directorate of census operations in Maharashtra, 2011)

## 4.5 Land Holding

The details of land holding of Akola district are presented in Table 4.4.

**Table 4.4. Land holding in Akola district**

| Sr. No. | Land holding (ha) | Land holders (%) | Area (%) |
|---|---|---|---|
| 1. | 0-2 | 52.93 | 22.12 |
| 2. | 2-5 | 32.68 | 33.61 |
| 3. | 5-10 | 11.28 | 27.23 |
| 4. | 10-20 | 2.02 | 12.98 |
| 5. | 20-50 | 0.20 | 2.06 |
| 6. | Above 50 | - | - |

(Source: District Socio-economic Review, 2008-09)

## 4.6 Land Utilization Pattern

Land utilization pattern of Akola district is presented in table 4.5 the district has the geographical area951126 hectare of which 62.95 per

cent is under cultivation. Area sown more than once 19813 hectare, while gross cropped area is 598756 hectare, area under forest is 123850 hectare. The area not available for cultivation and follow land is 95273 and 35268 hectare respectively.

**Table 4.5. Land utilization pattern in Akola district**

| Sr. No. | Particular | Area (ha) | Percent to total area |
|---|---|---|---|
| 1. | Total geographical area | 951126 | 100 |
| 2. | Area under forest | 123850 | 13.02 |
| 3. | Barren and uncultivable land | 41396 | 4.35 |
| 4. | Permanent pastures and other grazing land | 123 | 0.02 |
| 5. | Land under miscellaneous tree crops and grooves not included in net area sown | 233 | 0.03 |
| 6. | Cultivable waste land | 98 | 0.01 |
| 7. | Land put under non-agricultural use | 25936 | 2.73 |
| 8. | Current fallow | 35268 | 3.70 |
| 9. | Other Fallow | 30193 | 3.17 |
| 10. | Land not available for cultivation | 95273 | 10.02 |
| 11. | Net sown area | 578925 | 60.86 |
| 12. | Area sown more than once | 19813 | 2.09 |
| | Gross cropped area | 598756 | 62.95 |

(Source: Districtwise statistical information of Maharashtra 2009-10)

## 4.7 Cropping Pattern

Data on cropping pattern of Akola district is presented in table 4.6 the table reveals that soybean, cotton and jowar are the important crops grown in Akola these crop accounts for more than 50 per cent of the total crop area. Gram and Wheat are important crop of the district grown in rabi season safflower also important oilseed crops Tur is important pulse crop of the district. Thus cropping pattern of the district is diversifying in nature.

**Table 4.6. Cropping pattern in Akola district**

| Sr. No. | Crop | Area (ha) | Percentage to total |
|---|---|---|---|
| 1. | Wheat | 26500 | 4.43 |
| 2. | Kharifjowar | 54600 | 9.12 |
| 3. | Bajra | 3000 | 0.50 |
| 4. | Other cereals. | 3700 | 0.62 |
| | **Total cereals.** | **87800** | **14.67** |
| 5. | Gram | 54500 | 9.10 |
| 6. | Tur | 95600 | 15.97 |
| 9. | Other Pulses | 75102 | 12.54 |
| | **Total Pulses** | **225202** | **37.51** |
| 10. | Sugarcane | 3452 | 0.57 |
| 11. | Cotton | 164100 | 27.40 |
| 12. | Soybean | 85600 | 14.30 |
| 13. | Sunflower | 7264 | 1.22 |
| 14. | Safflower | 8421 | 1.41 |
| 15. | Groundnut | 4315 | 0.73 |
| 16. | Other crops | 13102 | 2.19 |
| | Gross cropped area | 598756 | 100 |

(Source: DSAO Akola, 2009-10)

## 4.8 Crop Season and Crop Rotation

There are two important crop growing in district Soybean, Cotton and jawar are the important crop grown in kharif season wheat and gram seasons i.e. kharif and Rabi where as in summer season land generally remains fallow and preparatory tillage operations are carried out.

The manner in which crop rotations are commonly followed is presented in Table 4.7.

**Table 4.7. Crop season and crop rotation in Akola district**

| Sr. No. | Kharif | Rabi |
|---|---|---|
| 1. | Cotton | - |
| 2. | Cotton + Tur + Jowar | - |
| 3. | Jowar | Gram |
| 4. | Cotton + Mung + Udid | Wheat |
| 5. | Cotton + Tur + Mung | Gram |
| 6. | Jowar | Safflower / wheat |
| 7. | Cotton + Tur | Safflower |
| 8. | Cotton + Tur + Jowar + Mung | Sunflower |
| 9. | Mung | Safflower |
| 10. | Cotton + Mung | - |
| 11. | Soybean | Wheat |

(Source: District Socio-economic Review, 2008-09)

## 4.9 Input Supply

Agricultural inputs like seed, manure, fertilizers, insecticides, pesticides etc. required to the farmers are made available to them through number of agricultural service centres established at district level and block levels.

Maharashtra State Seed Corporation and other private seed companies supply quality seeds to the farmers. The farm input are made available to the farmers by co-operative societies functioning at block level, Panchayat Samiti also provides inputs to the farmers. Co-operative society supply input against the loan sanctioned by DCCB to individual cultivator.

## 4.10 Markets

For the marketing of agricultural produce, agricultural market committees are functioning in the district. All seven tahsils having facilities of regulated markets are functioning in the district. These sub-markets are connected with roads and having facilities of banking, electricity etc.

## 4.11 Credit Supply

The credit supply in Akola district is done by Primary Agriculture Co-operative Credit Society, Non-agricultural credit Society, Panan Sanstha, Production Society and Social Service Society.

**Table 4.8. Credit Supply in Akola district**

| Sr. No. | Credit Society | Number | Working capital (Lakh ₹) | Loan given (Lakh ₹) |
|---|---|---|---|---|
| 1. | Primary Agricultural Co-operative credit Society | 413 | 10180 | 495942 |
| 2. | Non-agricultural credit society | 273 | 210392 | 5859 |
| 3. | Panan Sanstha (Marketing societies) | 14 | 58783 | - |
| 4. | Production Society | 395 | - | - |
| 5. | Social Service Society | 687 | - | - |

(Source: District Socio-economic Review, 2008-09)

# CHAPTER V

# RESULTS AND DISCUSSION

This chapter reveals the results and discussion under following heading and it is presented in view of the objectives of the study.

5.1 To examine the performance of major crops

5.2 To study the changes in cropping pattern

5.3 To study extent of crop diversification

5.4 To study benefits of crop diversification

## 5.1 To Examine the Performance of Major Crops

### 5.1.1 Growth rate of area, production and productivity

Performance of major crops of selected tahsils in Akola district can be ascertained through studying the growth in area, production and productivity. Compound growth rate of area, production and productivity of major crops were worked out for the period 1995-96 to 2009-10 and discussed below.

The growth rate study is restricted for entire study period as the minimum requirement of time series data for computing growth rate is 10 + 1 i.e. eleven year as such it is not possible to split up entire period into two or more sub periods.

**1) Growth rate of area, production and productivity of major crops in Akot tahsil**

The compound growth rates of area, production and productivity of major crops in Akot tahsil are presented in Table 5.1.

It is revealed from the table that the growth of area under Soybean, Wheat, Tur and Gram was positively significant indicated that

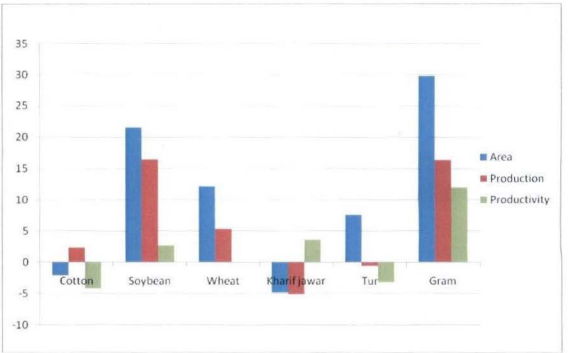


**Fig. 2. Compound growth rate of area, production and productivity of major crops in Akot tahsil**

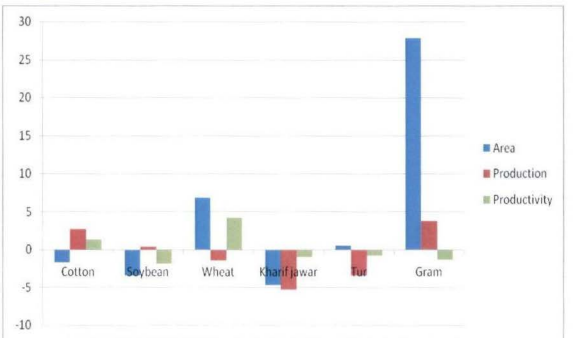


**Fig. 3. Compound growth rate of area, production and productivity of major crops in Balapur tahsil**

**Table 5.2. Compound growth rate of area, production and productivity of major crops in Balapur tahsil**

| Crops | Area | Production | Productivity |
|---|---|---|---|
| Cotton | -1.72 *** | 2.69 | 1.32 |
| Soybean | -3.40 | 0.33 *** | -1.9 |
| Wheat | 6.86 | -1.42 | 4.23* |
| Kharif jawar | -4.65 | -5.34 | -1.01 |
| Tur | 0.55 | -3.44 | -0.79 |
| Gram | 27.85 ** | 3.81 | -1.33 |

***, **, * denote significance at 1, 5 and 10 per cent, respectively.

It is observed from the Table 5.2 that growth rate of area of gram was positively significant indicated that increasing area under gram by 27.85 per cent. It is also observed from the table that area under cotton was (1.72) negative but significant. However, the area of soybean, wheat, kharif jawar and tur shows non significant result.

As regards to production it is observed from the Table 5.2 that the growth of production of soybean was positively significant indicated that increasing production by 0.33 per cent over the entire study period. However, the production of cotton, wheat, kharif jawar, tur and gram hows non-significant results.

In case of productivity the table revels that the growth rate of wheat shows positively significant which indicated the increasing productivity wheat by 4.23 per cent. The productivity in soybean, kharif jawar, tur, gram cotton shows non significant result.

**3) Growth rate of area, production and productivity of major crops in Murtijapur tahsil**

The compound growth rates of area, production and productivity of major crops in Murtijapur tahsil are presented in Table 5.3.

**Table 5.3. Compound growth rate of area, production and productivity of major crops of Murtijapur tahsil**

| Crops | Area | Production | Productivity |
|---|---|---|---|
| Cotton | -2.58 ** | -3.04 | -1.1 |
| Soybean | 6.38 | 1.42 | -2.28 |
| Wheat | 15.38 ** | 13.83 *** | 1.76 |
| Kharif jawar | -4.46 ** | -5.72 | -0.92 |
| Tur | 2.66 | 0.21 | 0.86 |
| Gram | 14.40 *** | 9.53 | -3.99 |

***, **, * denote significance at 1, 5 and 10 per cent, respectively.

It is seen from the table that the area under Wheat and Gram was positively significant indicated that increasing area under wheat 15.38 per cent and gram 14.40 per cent respectively. It is also observed from the table that area under cotton and kharif jawar was negative but significant indicated that decreasing area of cotton and jawar by 2.58 and 4.46 per cent respectively. However the area of soybean and tur shows non significant result.

As regards to production it is observed from the Table 5.3 that the growth of production of wheat was positively significant indicated that increasing production by 13.83 per cent over the entire study period. However, the production of cotton, kharif jawar, tur and gram shows non-significant results.

In case of productivity the table revels that the productivity of selected crops shows non significant result in entire study period.

**4) Growth rate of area, production and productivity of major crops in Patur tahsil**

The compound growth rates of area, production and productivity of major crops in Patur tahsil are presented in Table 5.4.

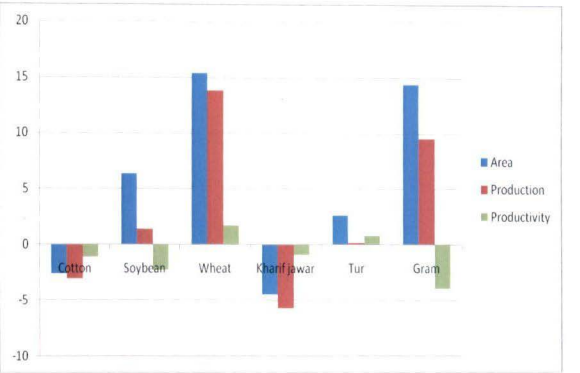


**Fig. 4. Compound growth rate of area, production and productivity of major crops of Murtijapur tahsil**

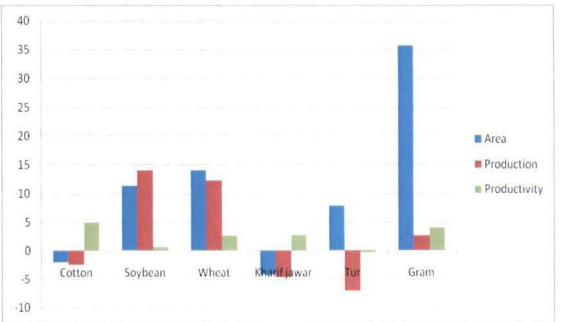


**Fig. 5. Compound growth rate of area, production and productivity of major crops in Patur tahsil**

**Table 5.4. Compound growth rate of area, production and productivity of major crops in Patur tahsil**

| Crops | Area | Production | Productivity |
|---|---|---|---|
| Cotton | -2.05 * | -2.46 | 4.88 |
| Soybean | 11.32 *** | 14.03 *** | 0.64 |
| Wheat | 14.03 ** | 12.22 * | 2.62 |
| Kharif jawar | -4.24 *** | -4.63 | 2.72 |
| Tur | 7.84 *** | -7.09 ** | -0.36 |
| Gram | 35.76 *** | 2.68 | 4.06 |

***, **, * denote significance at 1, 5 and 10 per cent, respectively.

From the Table 5.4 is revealed that the area under growth of Soybean, Wheat Tur and Gram was positively significant indicated that increasing area under soybean by 11.32 per cent, wheat 14.03 per cent, tur 7.84 per cent, and gram 35.76 per cent respectively. It is also observed from the table area under cotton and kharif jawar was negative but significant at 10 and 1 per cent level indicated that decreased by 2.05 and 4.24 per cent respectively.

In case of production it is observed that the growth of production of soybean and wheat was positively significant 1 and 10 per cent level indicated that increasing production by 14.03 per cent and 12.22 per cent respectively over the entire study period. It is also observed from the table that the area under tur was negative but significant indicating decreasing production of tur by 7.09 per cent. However, the production of cotton, kharif jawar and gram shows non-significant results.

In case of productivity of cotton, soybean, wheat, kharif jawar, tur and gram shows non significant result over entire study period.

**5) Growth rate of area, production and productivity of major crops in Akola district**

The compound growth rates of area, production and productivity of major crops in Akola district are presented in Table 5.5.

**Table 5.5. Compound growth rate of area, production and productivity of major crops in Akola district**

| Crops | Area | Production | Productivity |
|---|---|---|---|
| Cotton | -5.84 *** | -0.64 | 4.77 * |
| Soybean | 11.60 *** | 4.73** | -6.06 |
| Wheat | 3.67 | 6.25 | 3.02 ** |
| Kharif jawar | -8.56 *** | 0.04 | 1.74 |
| Tur | -2.67 ** | -4.74 | -2.02 |
| Gram | 4.09 | 4.98 | 1.72 |

***, **, * denote significance at 1, 5 and 10 per cent, respectively.

From the Table 5.5, it is revealed that the area under Soybean was positively significant at 1 per cent level indicated the area under soybean was decreased by 11.60 per cent. It is also observed from the table that area under cotton, kharif jowar and tur was negative but significant indicated that decreasing by 5.84 per cent, 8.56 per cent and 2.67 per cent.

In case of production most of the crops shows non significant growth rate in production. Soybean is only crop recording positive and significant growth rate of 4.73 per cent per annum.

In case of productivity the table revels that the growth rate of cotton and wheat, shows positively significant at 1 per cent and 5 per cent level which indicated increased the productivity of cotton 4.77 per cent and wheat 3.02 per cent respectively. The productivity of soybean, tur, kharif jawar and gram shows non-significant results.

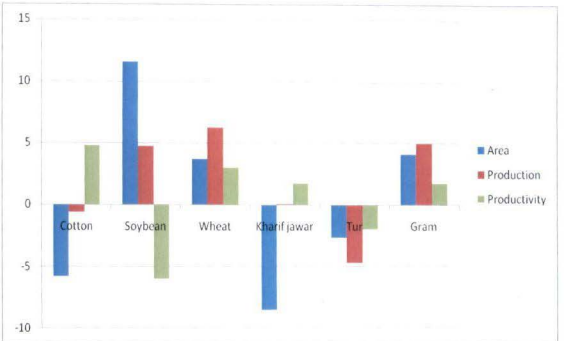


**Fig. 6. Compound growth rate of area, production and productivity of major crops in Akola district**

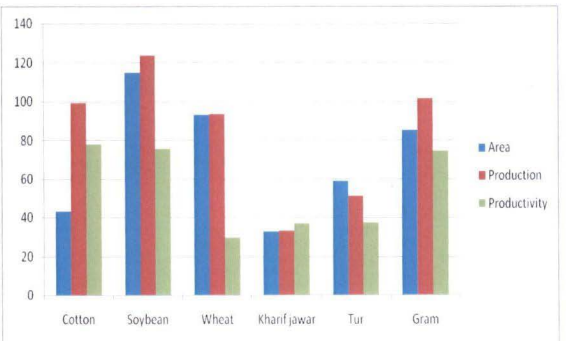


**Fig. 7. Coefficient of variation of area, production and productivity of major crops in Akot tahsil**

### 5.1.2. Coefficient of variation

#### 1) Coefficient of variation in area, production and productivity of major crops in Akot tahsil

Coefficient of variation of area, production and productivity was worked out and are presented in Table 5.6.

**Table 5.6. Coefficient of variation of area, production and productivity of major crops in Akot tahsil**

| Crops | Area | Production | Productivity |
|---|---|---|---|
| Cotton | 42.92 | 99.27 | 77.78 |
| Soybean | 114.64 | 123.67 | 75.48 |
| Wheat | 93.15 | 93.40 | 29.90 |
| Kharif jawar | 32.82 | 33.22 | 37.11 |
| Tur | 58.60 | 51.15 | 37.27 |
| Gram | 85.10 | 101.30 | 74.36 |

As seen from Table that the coefficient of variation of area in entired study period was highest (114.64 per cent) in soybean followed by wheat (93.15 per cent), gram (85.10 per cent) and tur (58.60 per cent). The coefficient of variation of area for overall period was lowest in kharif jawar ( 32.82 per cent).

In case of production coefficient of variation was highest in soybean i.e. 123.67 per cent followed by gram 101.30 per cent, cotton 99.27 per cent, wheat 93.13 per cent and tur 51.15 per cent during study period.

The coefficient of variation for productivity was highest in cotton i.e. 77.78 per cent and lowest in wheat i. e. 29.90 per cent.

**2) Coefficient of variation in area, production and productivity of major crops in Balapur tahsil**

Results on coefficient of variation of area, production and productivity are presented in Table 5.7.

**Table 5.7. Coefficient of variation of area, production and productivity of major crops in Balapur tahsil**

| Crops | Area | Production | Productivity |
|---|---|---|---|
| Cotton | 11.17 | 34.08 | 39.30 |
| Soybean | 274.48 | 147.68 | 74.63 |
| Wheat | 69.77 | 65.84 | 63.30 |
| Kharif jawar | 40.00 | 57.57 | 33.19 |
| Tur | 12.76 | 43.45 | 33.20 |
| Gram | 89.75 | 63.93 | 54.75 |

As seen from Table 5.7 that the coefficient of variation of area for overall period was highest in soybean i.e. 274.48 per cent followed by gram 89.75 per cent. The coefficient of variation of area for entire study period was lowest in cotton i. e. 11.17 per cent..

As revealed from Table 5.7, coefficient of variation of production was highest in soybean i.e. 147.68 per cent followed by wheat 65.84 per cent during study period. The coefficient of variation of production for overall period was lowest in cotton i. e. 34.08 per cent..

As revealed from Table 5.7, coefficient of variation of productivity was highest in soybean i.e. 74.63 per cent followed by wheat 63.30 per cent during study period. The coefficient of variation of productivity for overall period was lowest in kharif jawar i. e. 33.19 per cent..

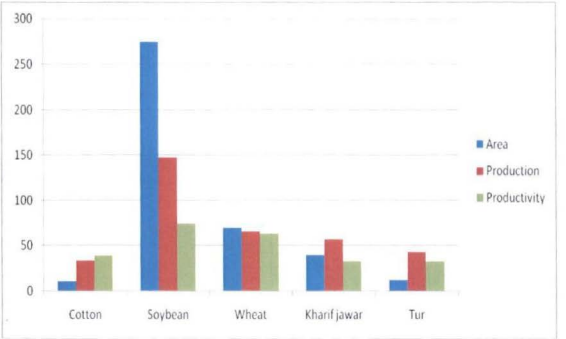


**Fig. 8. Coefficient of variation in area, production and productivity of major crops in Balapur tahsil**

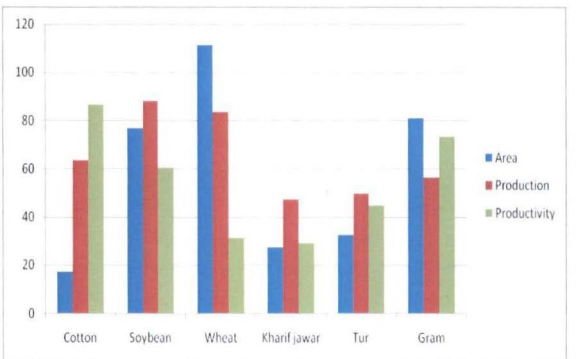


**Fig. 9. Coefficient of variation of area, production and productivity of major crops in Murtijapur tahsil**

**4) Coefficient of variation in area, production and productivity of major crops in Patur tahsil**

Results on coefficient of variation of area, production and productivity are presented in Table 5.9.

**Table 5.9. Coefficient of variation of area, production and productivity of major crops in Patur tahsil**

| Crops | Area | Production | Productivity |
|---|---|---|---|
| Cotton | 20.77 | 51.94 | 38.50 |
| Soybean | 55.93 | 72.22 | 60.65 |
| Wheat | 118.59 | 105.19 | 35.54 |
| Kharif jawar | 22.14 | 41.67 | 39.20 |
| Tur | 39.40 | 47.37 | 47.65 |
| Gram | 101.58 | 85.42 | 52.21 |

As seen from Table 5.9, that the coefficient of variation of area for overall period was highest in wheat i.e. 118.59 per cent followed by gram 101.58 per cent. The coefficient of variation of area for overall period was lowest in cotton i. e. 20.77 per cent.

As revealed from Table 5.9, coefficient of variation of production was highest in wheat i. e. 105.19 per cent followed by gram 85.42 per cent during study period. The coefficient of variation of production for overall period was lowest in kharif jawar i. e. 41.67 per cent..

As revealed from Table 5.9, coefficient of variation of productivity was highest in gram i.e. 52.21 per cent followed by tur 47.65 per cent during study period. The coefficient of variation of productivity for overall period was lowest in wheat i. e. 35.54 per cent..

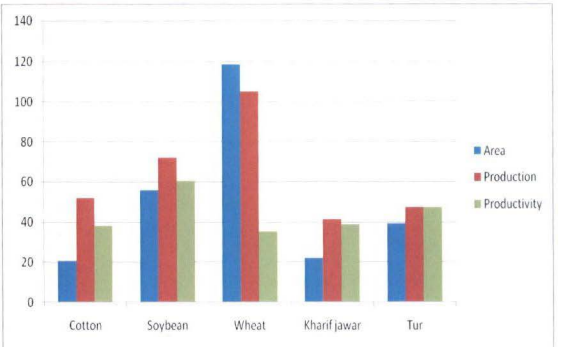


**Fig. 10. Coefficient of variation of area, production and productivity of major crops in Patur tahsil**

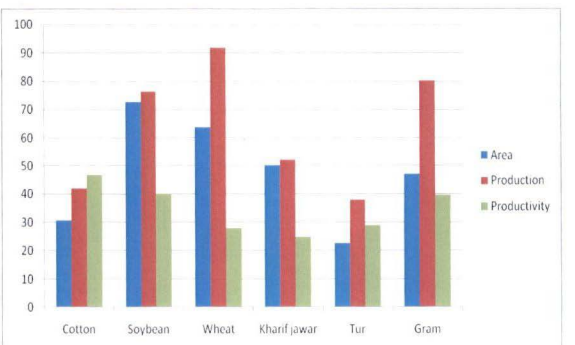


**Fig. 11. Coefficient of variation of area, production and productivity of major crops in Akola district**

**5) Coefficient of variation in area, production and productivity of major crops in Akola district**

Results on coefficient of variation of area, production and productivity are presented in Table 5.10.

**Table 5.10. Coefficient of variation of area, production and productivity of major crops in Akola district**

| Crops | Area | Production | Productivity |
|---|---|---|---|
| Cotton | 30.72 | 42.12 | 46.80 |
| Soybean | 72.63 | 76.28 | 40.16 |
| Wheat | 63.77 | 91.76 | 28.05 |
| Kharif jawar | 50.29 | 52.06 | 24.92 |
| Tur | 22.78 | 38.00 | 28.94 |
| Gram | 47.08 | 80.11 | 39.57 |

As seen from Table 5.10, that the coefficient of variation of area for overall period was highest in soybean i.e. 72.63 per cent followed by wheat 63.77 per cent. The coefficient of variation of area for overall period was lowest in tur i. e. 22.78 per cent..

As revealed from Table 5.10, coefficient of variation of production was highest in wheat i. e. 91.76 per cent followed by gram 80.11 per cent during study period. The coefficient of variation of production for overall period was lowest in tur i. e. 38.00 per cent.

As revealed from Table 5.10, coefficient of variation of productivity was highest in cotton i.e. 46.80 per cent followed by soybean 40.16 per cent during study period. The coefficient of variation of productivity for overall period was lowest in kharif jawar i. e. 24.92 per cent..

## 5.2 To study the changes in Cropping Pattern

The cropping pattern of particular region emerges and also changes through the interaction of physical, social, economic, technological and infrastructural factors. The decisions of a farmer regarding cropping pattern are based on monetary returns, availability of production technologies, accessibility of resources and many others. During last two decades, considerable changes have been occurred in the agricultural scenario. These changes have results in to a drastic changes in the cropping pattern of the region. So, it is essential to examine the magnitude and direction of changes in the cropping pattern over two decades.

The changes in cropping pattern have been examined for Akola district as a whole and four tahsils of Akola district i.e.Akot, Balapur, Murtijapur and Patur. The changes in the cropping pattern were estimated for the period 1995-96 to 2009-10. The area under selected crops and the relative share of each crop in the gross cropped area at different points of time have been used to study the changes in cropping pattern.

**1) Changes in cropping pattern in Akot tahsil**

The changes in cropping pattern in Akot tahsil during 1995-96 to 2009-10 are presented in Table 5.11.

It is observed from the table that, Cotton and jowar were observed as major crops during 1995-96 contributed 70.52 per cent of gross cropped area. In the span of 15 years cropping pattern has changed substantially in the tahsil. The proportion of jowar was 21.69 per cent in the year 1995-96 has reduced to 17.55 per cent in 2000-01 then increased to 26.89 per cent and after that it is reduced to 13.39 per cent.

**Table 5.11. Changes in cropping pattern in Akot tahsil (Area in ha)**

| Sr. No. | Crops | Period | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1995-96 | 2000-01 | | 2005-06 | | 2009-10 | |
| | | 1995-96 | 2000-01 | % change over 1995-96 | 2005-06 | % change over 1995-96 | 2009-10 | % change over 1995-96 |
| 1 | Cotton | 36696 (48.83) | 40542 (49.98) | 10.48 | 29200 (35.22) | -20.43 | 26800 (31.75) | -26.96 |
| 2 | Soybean | 1800 (2.39) | 2800 (3.46) | 55.56 | 6900 (8.32) | 283.33 | 9700 (11.49) | 438.89 |
| 3 | Wheat | 700 (0.93) | 1778 (2.19) | 154 | 550 (0.67) | -21.43 | 1150 (1.36) | 64.29 |
| 4 | Kharif Jawar | 16301 (21.69) | 14239 (17.55) | -12.64 | 22300 (26.89) | 136.14 | 11300 (13.39) | -30.68 |
| 5 | Tur | 3049 (4.06) | 2667 (3.28) | -12.52 | 7200 (8.68) | 36.80 | 9540 (11.30) | 212.89 |
| 6 | Gram | 200 (0.26) | 3199 (3.95) | 1499.5 | 1134 (1.37) | 467 | 9540 (11.30) | 4670 |
| 7 | Other crops | 16396 (21.84) | 15899 (19.59) | -3.03 | 15634 (18.85) | -4.65 | 16385 (19.41) | -0.07 |
| 8 | Gross cropped area | 75142 (100) | 81124 (100) | 6.63 | 82918 (100) | 10.35 | 84415 (100) | 12.34 |

(Figures in the parentheses are percentages over gross cropped area)

In case of cotton, its share in gross cropped area has fallen to the level of 31.75 per cent in 2009-10 from 48.83 per cent in 1995-96. The proportion of area under wheat and soybean in gross cropped area were found to be increased for the entire period i.e. 1995-96 to 2009-10.

On the other hand increasing proportion of area was observed in tur and gram. for the entire period i.e. 1995-96 to 2009-10.

**2) Changes in cropping pattern in Balapur tahsil**

The changes in cropping pattern in Balapur during 1995-96 to 2009-10 are presented in Table 5.12.

**Table 5.12. Changes in cropping pattern in Balapur tahsil** (Area in ha)

| Sr. No. | Crops | Period | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1995-96 | 2000-01 | | 2005-06 | | 2009-10 | |
| | | 1995-96 | 2000-01 | % change over 1995-96 | 2005-06 | % change over 1995-96 | 2009-10 | % change over 1995-96 |
| 1 | Cotton | 28258 (43.76) | 34650 (51.06) | 22.62 | 29400 (42.97) | 4.04 | 25400 (35.55) | -10.11 |
| 2 | Soybean | 1700 (2.63) | 5600 (8.25) | 229.41 | 7200 (10.52) | 323.52 | 13900 (19.45) | 717.65 |
| 3 | Wheat | 255 (0.39) | 450 (0.66) | 76.47 | 250 (0.38) | -1.96 | 1450 (2.03) | 468.62 |
| 4 | Kharif Jawar | 16251 (25.17) | 8650 (12.74) | -46.77 | 11600 (16.95) | -28.62 | 5300 (7.42) | -67.38 |
| 5 | Tur | 4918 (7.63) | 5480 (8.06) | 11.42 | 6400 (9.35) | 30.13 | 7100 (9.94) | 44.36 |
| 6 | Gram | 558 (0.86) | 537 (0.79) | -3.76 | 2225 (3.25) | 298.74 | 4150 (5.81) | 643.73 |
| 7 | Other crops | 12622 (19.55) | 12497 (18.41) | -0.99 | 11337 (16.58) | -10.18 | 14152 (19.80) | 12.12 |
| 8 | Gross cropped area | 65462 (100) | 67864 (100) | 3.66 | 68412 (100) | 4.50 | 71452 (100) | 9.15 |

(Figures in the parentheses are percentages over gross cropped area)

It is seen from the table that, cotton and jowar contributed 68.93 per cent of gross cropped area. In the span of 15 years cropping pattern has changed substantially in the tahsil. The proportion of jowar was 25.17 per cent in the year 1995-96 has reduced to 7.42 per cent in 2009-10. In case of cotton, its share in gross cropped area has increased to the level of 43.76 per cent in 1995-96 to 51.06 per cent in 2009-10 after that it was decreased up to 35.55 per cent in 2009-10. The proportion of area under tur crop was found to be nearly constant for entire period 1995-95 to 2009-10. The increased proportion of area was observed in respect of

wheat. The proportion of area under soybean was 2.63 per cent in 1995-96 and it was increased upto 2009-10 i.e. 19.45 per cent.

The proportion of area under gram was highest in 2009-10 i.e. 5.81 per cent and proportion of area under wheat was lowest in 1995-96 i.e. 0.39 per cent and it is highest in 2009-10 i. e. 2.03 per cent. The gross cropped area of Balapur tahsil showed variations in 1995-96 year to in 2009-10 year.

**3) Changes in cropping pattern in Murtijapur tahsil**

The changes in cropping pattern in Murtijapur tahsil during 1995-96 to 2009-10 are presented in Table 5.13.

**Table 5.13. Changes in cropping pattern in Murtijapur tahsil**

**(Area in ha)**

| Sr. No. | Crops | Period | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1995-96 | 2000-01 | | 2005-06 | | 2009-10 | |
| | | 1995-96 | 2000-01 | % change over 1995-96 | 2005-06 | % change over 1995-96 | 2009-10 | % change over 1995-96 |
| 1 | Cotton | 37259 (45.86) | 35372 (41.68) | -5.06 | 34200 (39.02) | -8.21 | 22400 (24.98) | -39.58 |
| 2 | Soybean | 13300 (16.32) | 20200 (23.80) | 51.87 | 21700 (24.78) | 63.15 | 26790 (29.88) | 101.42 |
| 3 | Wheat | 125 (0.16) | 779 (0.93) | 523.2 | 510 (0.59) | 308 | 1310 (1.46) | 948 |
| 4 | Kharif Jawar | 12511 (15.39) | 6916 (8.15) | -44.72 | 5500 (6.28) | -56.03 | 3600 (4.01) | -71.22 |
| 5 | Tur | 3982 (4.90) | 4934 (5.81) | 23.90 | 6800 (7.77) | 70.76 | 9400 (10.49) | 136.06 |
| 6 | Gram | 940 (1.16) | 2648 (3.12) | 181.70 | 3790 (4.33) | 303.19 | 8650 (9.65) | 820.21 |
| 7 | Other crops | 13138 (16.16) | 14008 (16.51) | 6.62 | 15.53 (17.19) | 14.57 | 17496 (19.52) | 33.17 |
| 8 | Gross cropped area | 81200 (100) | 84857 (100) | 4.50 | 87553 (100) | 7.82 | 89646 (100) | 10.40 |

(Figures in the parentheses are percentages over gross cropped area)

It is seen from the table that, cotton and jowar contributed 61.25per cent of gross cropped area. In the span of 15 years cropping pattern has changed substantially in the tahsil. The proportion of jowar was 15.39 per cent in the year 1995-96 has reduced to 4.01 per cent in 2009-10. In case of cotton, its share over gross cropped area has fallen to the level of 24.98 per cent in 2009-10 from 45.86 per cent in 1995-96. The proportion of area under tur, over gross copped area were found to be increased for the entire period 1995-96 to 2009-10.Increased proportion of area was observed in respect of wheat i.e. 0.16 per cent to 1.46 per cent.

The increasing proportion of area was observed in soybean from 1995-96 to 2009-10 up to 29.88 per cent. Proportion of area under cotton was highest in 1995-96 i.e. 45.86 per cent and proportion of area under soybean was highest in 2009-10 i.e. 29.88 per cent.

**4) Changes in cropping pattern in Patur tahsil**

The changes in cropping pattern in Patur tahsil during 1995-96 to 2009-10 are presented in Table 5.14.

It is observed from the Table 5.14, that cotton and jowar contributed 67.82 per cent of gross cropped area. In the span of 15 years cropping pattern has changed substantially in the tahsil. The proportion of jowar was 21.67 per cent in the year 1995-96 has reduced 9.57 per cent in 2009-10. In case of cotton, its share over gross cropped area has fallen to the level of 28.08 per cent in 2009-10 from 46.15 per cent in 1995-96. The proportion of area under wheat over gross cropped area were found to be increased for period 1995-96 to 2009-10 year up to 1.89 per cent to 3.51 per cent. Increased proportion of area was observed in respect of soybean, tur and gram. Proportion of area under soybean was highest in 2009-10 i.e. 28.23 per cent.

**Table 5.14. Changes in cropping pattern in Patur tahsil**

**(Area in ha)**

| Sr. No. | Crops | Period | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1995-96 | 2000-01 | | 2005-06 | | 2009-10 | |
| | | 1995-96 | 2000-01 | % change over 1995-96 | 2005-06 | % change over 1995-96 | 2009-10 | % change over 1995-96 |
| 1 | Cotton | 27741 (46.15) | 20558 (33.37) | -25.89 | 98000 (31.78) | -28.63 | 18200 (28.08) | -34.39 |
| 2 | Soybean | 4500 (7.48) | 13700 (22.24) | 204.44 | 15750 (25.28) | 250 | 18300 (28.23) | 306.67 |
| 3 | Wheat | 1139 (1.89) | 1380 (2.24) | 21.16 | 1270 (2.04) | 11.50 | 2270 (3.51) | 99.29 |
| 4 | Kharif Jawar | 13023 (21.67) | 11535 (18.73) | -11.43 | 8700 (13.97) | -33.19 | 6200 (9.57) | -52.39 |
| 5 | Tur | 2104 (3.49) | 3104 (5.04) | 47.53 | 4600 (7.38) | 118.63 | 5700 (8.79) | 170.91 |
| 6 | Gram | 145 (0.24) | 1088 (1.77) | 650.34 | 2010 (3.23) | 1286.21 | 2510 (3.87) | 1631.03 |
| 7 | Other crops | 11471 (19.08) | 10233 (16.61) | -10.79 | 10161 (16.31) | -11.42 | 11634 (17.95) | 1.42 |
| 8 | Gross cropped area | 60123 (100) | 61598 (100) | 2.45 | 62291 (100) | 3.61 | 648141 (100) | 7.80 |

(Figures in the parentheses are percentages over gross cropped area.)

**5) Changes in cropping pattern in Akola district**

The changes in cropping pattern in Akola district during 1995-96 to 2009-10 are presented in Table 5.15.

**Table 5.15. Changes in cropping pattern in Akola district**

**(Area in ha)**

| Sr. No. | Crops | Period | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1995-96 | 2000-01 | | 2005-06 | | 2009-10 | |
| | | 1995-96 | 2000-01 | % change over 1995-96 | 2005-06 | % change over 1995-96 | 2009-10 | % change over 1995-96 |
| 1 | Cotton | 377200 (45.19) | 227800 (45.52) | -47.64 | 197500 (35.63) | -39.60 | 164100 (27.40) | 56.50 |
| 2 | Soybean | 24000 (2.87) | 28900 (5.77) | 155 | 61200 (11.04) | 20.41 | 85600 (14.30) | 256.67 |
| 3 | Wheat | 19800 (2.37) | 9700 (1.93) | -43.43 | 11200 (2.02) | -51.0 | 26500 (4.43) | 33.84 |
| 4 | Kharif Jawar | 185600 (22.23) | 86100 (17.19) | -53.34 | 86600 (15.62) | -98.79 | 54600 (9.12) | -70.58 |
| 5 | Tur | 24000 (2.87) | 28900 (5.79) | 155 | 61200 (11.04) | 20.41 | 95600 (15.97) | 298.33 |
| 6 | Gram | 42000 (5.07) | 22000 (4.39) | -42.61 | 42000 (7.59) | 94.76 | 54500 (9.10) | 29.76 |
| 7 | Other crops | 161962 (19.40) | 97200 (19.41) | -41.63 | 94531 (17.06) | -39.98 | 117856 (19.68) | -27.23 |
| 8 | Gross cropped area | 834562 (100) | 500600 (100) | -33.59 | 554231 (100) | -40.01 | 598756 (100) | -28.26 |

(Figures in the parentheses are percentages over gross cropped area)

The changes in the cropping pattern of Akola district during 1995-96 to 2009-10 are presented in table 15. Kharif jawar and cotton contributed 22.23 and 45.19 per cent of gross cropped area. In the span of 15 years cropping pattern has changed substantially. The proportion of jawar was 22.23 per cent in the year 1995-96 has reduced to 9.12 per cent in 2009-10. In case of cotton, its share over gross cropped area has icreased to the level of 0.33 per cent in 2000-01 from 45.19 per cent in 1995-96, but thereafter decreased to 27.40 per cent in 2009-10. The proportion of area under gram over gross cropped area was increased in

the year 1995-96 to 2000-01. Increased proportion of area under soybean and tur was highest in 2009-10 i.e. 14.30 per cent and 15.76 per cent respectively. Proportion of area under wheat was highest in 2009-10 i.e. 4.43 per cent.

### 5.3 To study extent of Crop Diversification

The analysis of changes in cropping pattern indicates that diversification took place in selected tahsils of Akola district. The level of crop diversification varies in selected tahsils of Akola district because of varied agro-climatic conditions and resource endowment of the farms. Hence, an attempt was made to examine the level of crop diversification in selected tahsils of Akola district at different points of time.

Two types of crop diversification indices i.e. Herfindahl index and Entropy index were used to measure the level of crop diversification in present study.

**1) Measurement of crop diversification : Herfindahl index**

Herfindahl index is a measure of diversification. The value of Herfindahl index varies from zero to one. It takes the value one when there is complete specialization and value zero when there is perfect diversification.

Measurement of crop diversification in selected tahsils and in Akola district were presented in Table 5.16.

**Table 5.16. Measurement of crop diversification in selected tahsils and in Akola district**

| Year | Akot | Balapur | Murtijapur | Patur | Akola |
|---|---|---|---|---|---|
| 1995-96 | 0.34 | 0.30 | 0.29 | 0.30 | 0.30 |
| 2000-01 | 0.33 | 0.26 | 0.26 | 0.24 | 0.28 |
| 2005-06 | 0.20 | 0.25 | 0.28 | 0.20 | 0.21 |
| 2009-10 | 0.19 | 0.22 | 0.28 | 0.18 | 0.17 |

The Table 5.16 shows that in all tahsils of Akola district, the diversification index varied from 0.18 ( corresponding to Patur tahsil during the year 2009-10) and 0.34 (corresponding to Akot during the year 1995-96). All tahsils registered maximum increasing diversification during the 15 year from 1995-96 to 2009-10. In case of Akola district registered maximum increase in the diversification index (0.30 to 0.17) during the 15 years confirmed that crop diversification took place. The diversification from subsistence crop to more commercial crops were took place in these tahsils.

**2) Measurement of crop diversification : Entropy index**

Entropy index is also a measure of diversification. The value of Entropy index varies from zero to one. It takes the value one when there is perfect diversification and value zero when there is complete specialization.

Measurement of crop diversification in selected tahsils and in Akola district were presented in Table 5.17.

**Table 5.17. Measurement of crop diversification in selected tahsils and in Akola district**

| Year | Akot | Balapur | Murtijapur | Patur | Akola |
|---|---|---|---|---|---|
| 1995-96 | 0.76 | 0.66 | 0.63 | 0.61 | 0.69 |
| 2000-01 | 0.66 | 0.68 | 0.67 | 0.67 | 0.66 |
| 2005-06 | 0.74 | 0.69 | 0.66 | 0.74 | 0.74 |
| 2009-10 | 0.80 | 0.76 | 0.65 | 0.79 | 0.79 |

From the Table 5.17, it is revealed that in all the tahsils and Akola as a whole the value of Entropy index were more than 0.60 i.e. it is nearer to one at selected data points. It means diversification is increased in all tahsils including Akola district during the period of study.

## 5.4 To study benifits of Crop Diversification

In order to examine the benefits of diversification land concentration ratios of selected tahsils of Akola districts were computed and presented in Table 5.18 to 5.23.

**Table 5.18. Land concentration ratios of major crops in Akot tahsil**

| Year | Cotton | Kharif jawar | Soybean | Wheat | Tur | Gram |
|---|---|---|---|---|---|---|
| 1995-96 | 2.40 | 0.46 | 0.04 | 0.73 | 1.94 | 0.53 |
| 2000-01 | 1.77 | 0.54 | 0.25 | 0.93 | 0.79 | 0.33 |
| 2005-06 | 1.54 | 0.50 | 1.85 | 1.04 | 1.44 | 1.90 |
| 2009-10 | 1.59 | 0.51 | 1.93 | 0.95 | 1.40 | 1.77 |

From the Table 5.18, it is seen that the land concentration ratio of cotton and soybean from the year 1995-96 to 2009-10 showed increasing trend it means that cotton and soybean are more adventitious crops over jowar, wheat, tur, and gram in Akot tahsil.

**Table 5.19. Land concentration ratios of major crops in Balapur tahsil**

| Year | Cotton | Kharif jawar | Soybean | Wheat | Tur | Gram |
|---|---|---|---|---|---|---|
| 1995-96 | 2.50 | 1.32 | 1.11 | 0.21 | 1.29 | 0.73 |
| 2000-01 | 2.37 | 1.56 | 1.18 | 0.18 | 1.35 | 1.39 |
| 2005-06 | 1.64 | 1.46 | 1.40 | 1.30 | 1.44 | 1.21 |
| 2009-10 | 1.64 | 0.30 | 1.41 | 0.80 | 1.49 | 1.35 |

It is observed from the Table 5.19, that the land concentration ratio of soybean and tur from the year 1995-96 to 2009-10 showed increasing trend it means that soybean and tur are more adventitious crops over cotton, jowar, wheat and gram in Balapur tahsil.

**Table 5.20. Land concentration ratios of major crops in Murtijapur tahsil**

| Year | Cotton | Kharif jawar | Soybean | Wheat | Tur | Gram |
|---|---|---|---|---|---|---|
| 1995-96 | 1.74 | 0.88 | 1.25 | 0.79 | 1.17 | 0.65 |
| 2000-01 | 1.75 | 1.44 | 1.30 | 0.65 | 0.18 | 0.16 |
| 2005-06 | 1.80 | 0.55 | 1.36 | 0.96 | 1.30 | 0.83 |
| 2009-10 | 1.84 | 0.67 | 1.44 | 1.33 | 1.38 | 1.37 |

Table 5.20 revealed that the land concentration ratio of cotton, soybean and tur from the year 1995-96 to 2009-10 showed increasing trend it means that cotton and soybean are more adventitious crops over jawar, wheat, tur and gram in Murtijapur tahsil.

**Table 5.21. Land concentration ratios of major crops in Patur tahsil**

| Year | Cotton | Kharif jawar | Soybean | Wheat | Tur | Gram |
|---|---|---|---|---|---|---|
| 1995-96 | 1.69 | 0.93 | 1.39 | 0.95 | 1.60 | 0.55 |
| 2000-01 | 1.91 | 0.35 | 0.19 | 1.07 | 0.50 | 1.79 |
| 2005-06 | 2.42 | 0.27 | 1.22 | 1.10 | 1.52 | 0.92 |
| 2009-10 | 2.74 | 0.91 | 1.93 | 1.27 | 0.11 | 1.43 |

From the Table 5.21 it is seen that the land concentration ratio of cotton, and wheat from the year 1995-96 to 2009-10 showed increasing trend it means that cotton, and wheat are more adventitious crops over soybean, kharif jawar, tur and gram in Patur tahsil of Akola district.

**Table 5.22. Land concentration ratios of major crops in Akola district**

| Year | Cotton | Kharif jawar | Soybean | Wheat | Tur | Gram |
|---|---|---|---|---|---|---|
| 1995-96 | 1.83 | 0.79 | 1.87 | 0.48 | 1.68 | 0.60 |
| 2000-01 | 1.91 | 0.80 | 1.89 | 1.31 | 1.43 | 0.69 |
| 2005-06 | 1.98 | 1.14 | 1.96 | 1.29 | 1.26 | 1.61 |
| 2009-10 | 2.15 | 0.47 | 2.53 | 1.20 | 1.46 | 1.57 |

From the Table 5.22 it is seen that the land concentration ratio of soybean and cotton from the year 1995-96 to 2009-10 showed increasing trend it means that soybean and cotton are more adventitious crops over kharif jawar, wheat, tur and gram in Akola district.

## CHAPTER VI

# SUMMARY AND CONCLUSION

The study of crop diversification assumes a great significance as it is one of the important path for balanced development of agriculture to meet the human requirements. Diversification becomes necessary since cereals cannot alone support economic development not with standing the need to ensure food security. Diversification to commercial crops and minimize risk and earn foreign exchange. Diversification increased individual and social gains, helps in poverty alleviation, employment and environmental conservation. In the context of Indian agriculture, diversification has occurred across and with crops, livestock, horticultural sectors. Technological changes and government policies accelerate diversification to avoid monocropping.

So, in this context, an effort has been made to examine the change in cropping pattern, extent of crop diversification and benefits of crop diversification in Akola district. The specific objectives of this study were as under.

1) To examine the performance of major crops
2) To study the changes in cropping pattern
3) To study extent of crop diversification
4) To study benifits of crop diversification

The present study was based on secondary data collected from District Superintendent Agriculture Office Akola. The time series data on area, production and yield of Akola district were collected for the period 1995-96 to 2009-10.

The major crops selected for the study were cotton, soybean, kharif jowar, wheat, tur and gram.

Various statistical techniques were used to achieve the objectives of study. In order to examine the performance of different crops in Akola districts and four tahsils i.e. Akot, Balapur, Murtijapur and Patur compound growth rates and coefficient of variation have been computed at different points of time. In order to examine the changes in cropping pattern in selected tahsils along with Akola district, the percentage share of individual crops with respect to gross cropped area has been worked out at different points of time. In order to study the extent of crop diversification in selected tahsils along with Akola district. Diversification indices was computed at different points of time.To study the benifits of crop diversification land concentration ratios with comparative advantage was computed for selected crops at different points of time.

The results of the study are summarized as below.

### 6.1 To Examine the Performance of Major Crops

Compound growth rates of area, production and yield of major crops in Akola district revealed that, during the overall period. The compound growth rate of area of soybean, wheat and gram has positively significant in Akot, Patur tahsil and Akola district.The compound growth rate of cotton has negatively significant in Balapur, Murtijapur, Patur tahsil. The same result was observed in case of Akola district.

The compound growth rate of production of soybean has positively significant in Akot, Balapur and Patur tahsil. The compound growth rate of production of wheat has positively significant in Murtijapur and Patur tahsil. Cotton has non-significant result for all tahsils. In Akot tahsil jawar shows significant result and in remaining all tahsils shows non

significant result. The growth in production of jawar shows non significant result in all tahsils except Akot tahsil.

The compound growth rate of productivity of wheat has shows significant result in Akot tahsil and Akola district. In Akot tahsil gram shows significant result and in remaining all tahsils shows non significant result. In Akot tahsil and Akola district cotton shows significant result. The compound growth rate of productivity of remaining all crops shows non-significant result in all tahsils along with Akola district.

### 6.2 To Study the Changes in Cropping Pattern

The analysis of cropping pattern changes in Akola district revealed that cotton, soybean and tur were the major crops of Akola district. Soybean is emerging as one of the major crop of the district. The tahsilwise proportion of area under soybean in Akot (11.49%), Balapur (19.45%), Murtijapur (29.88%) and Patur(28.23%) during 2009-10. The area under jowar is found to be decreasing in all tahsils (i.e. study area) of Akola district.

### 6.3 To Study Extent of Crop Diversification

In Akot, Balapur, Murtijapur and Patur tahsils crop diversification has significantly increase during the study period. The same result was shown in Akola district. The diversification from subsistence crop to more commercial crops were took place.

### 6.4 To Study the Benifits of Crop Diversification

Results showed that, soybean and cotton showed increasing land concentration ratio from year 1995-96 to 2009-10. So, soybean is more adventitious crop in Akot, Balapur, Murtijapur and Patur tahsils of Akola district.

## Conclusion

1) Area and production in soybean exibited significant increase in Akot and Patur tahsils.
2) Gram has been introduced as Rabi crop after soybean in all the tahsils under study.
3) Inconsistancy in performance of tur exhibited during the study the study period.
4) Area under kharif jawar has significantly declined over the study period.
5) Highest inconsistency in area, production and productivity of wheat and gram was observed in Patur tahsil.
6) The area under cotton, tur and khrif jawar is diverted to soybean in the district.
7) Per cent share of soybean and wheat area in cropping pattern found increasing for the period 1995-96 to 2009-10 in selected tahsils of Akola district.
8) Increased in crop diversification in all tahsils and in Akola district.
9) Soybean is more adventitious over cotton, kharif jawar, tur and gram.

## Implication

The following policy implication are brought out from important findings of present study.

1) Crop diversification is increased over the period of study in all the selected tahsils of Akola district. This should be noted while deciding the policy on cropping plan for these tahsils.
2) Area under cotton decreased over the period of study because of the uncertain price policy. Cotton cultivation stabilized in the Akola district as it is cash crop of farmers. There is need of long irrigation facility concrete and assured procrument policy.

## CHAPTER VII

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